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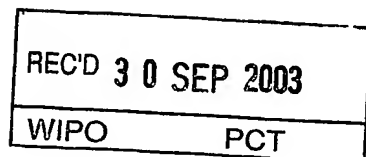
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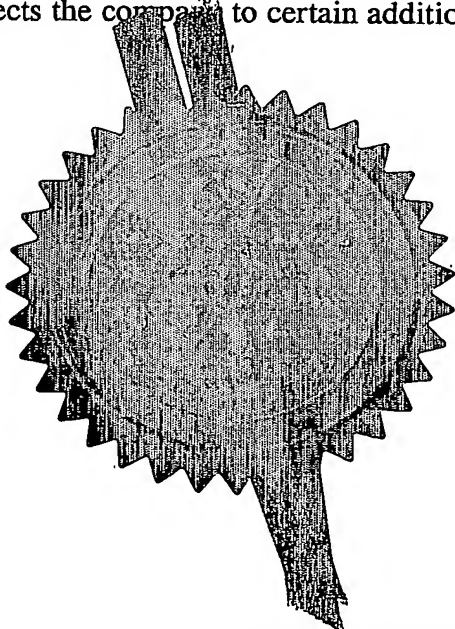


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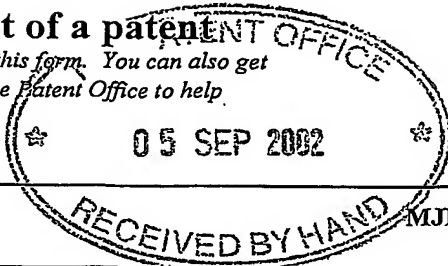
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06SEP02 E746243-1 D02882
P01/7700 0.00-0220685.2

The Patent Office

Request for grant of a patent

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Concept House
Cardiff Road
Newport
South Wales NP10 8QQ

1. Your reference MJD/60362/000

2. Patent application number
(The Patent Office will fill in this part)

0220685.2

05 SEP 2002

3. Full name, address and postcode of the or of
each applicant (underline all surnames)

Innogy plc
Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire SN5 6PB
GB

Patents ADP number (if you know it) 8110777001

If the applicant is a corporate body, give the
country/state of its incorporation GB

4. Title of the invention A cylinder for an internal combustion engine

5. Name of your agent (if you have one)

BOULT WADE TENNANT

"Address for service" in the United Kingdom
to which all correspondence should be sent
(including the postcode)

VERULAM GARDENS
70 GRAY'S INN ROAD
LONDON WC1X 8BT

Patents ADP number (if you know it)

42001

6. If you are declaring priority from one or more
earlier patent applications, give the country and the
date of filing of the or of each of these earlier
applications and (if you know it) the or each
application number

Country

Priority application number
(if you know it)

Date of filing
(day/month/year)

7. If this application is divided or otherwise derived
from an earlier UK application, give the number
and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant
of a patent required in support of this request?

Yes

(Answer 'Yes' if:

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

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Continuation sheets of this form -

Description 5

Claim(s) 2

Abstract -

Drawing(s) 1 + 1

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77) 1

Request for substantive examination (Patents Form 10/77)

Any other documents (Please specify)

11 I/We request the grant of a patent on the basis of this application.

Signature

Date

Bout Wade Tennant

5 September 2002

12. Name and daytime telephone number of person to contact in the United Kingdom Martyn J. Draper
020 7430 7500

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A CYLINDER FOR
AN INTERNAL COMBUSTION ENGINE

5 The present invention relates to a cylinder for
an internal combustion engine.

10 In particular, the invention relates to improving
the design of a cylinder where there will be high heat
transfer to the liner wall. The cylinder liner will
be cooled by a flow of coolant. The liner needs to
have enough thickness and strength to resist the
internal pressures and other mechanical forces, but
the thickness is limited both by local temperatures
and temperature gradients within the liner, which
15 cause thermal stresses and reduce the fatigue life.
The problem of achieving satisfactory cooling while
maintaining adequate strength and fatigue life is
greatest at the top of the liner because the local
heat fluxes are highest. It is also difficult to fit
20 in cooling channels very close to the junction between
the cylinder liner and the flame-plate at the top of
the cylinder.

25 It is common to insert a ring of suitable metal
at the top of the cylinder to scrape carbon off the
piston as it reaches top dead centre. This metal ring
can also act as a thermal barrier, which reduces the
local heat flux at the top of the cylinder liner.
Further, a composite ceramic sleeve at the top of the
30 liner is disclosed in US 4,921,734.

According to the present invention a cylinder for
an internal combustion engine comprises a wall
generally forming the cylinder, a coolant passage to
35 provide a flow of coolant around the wall, a metallic
ring radially inward of the wall at the upper end of
the cylinder, the metallic ring being capable of

withstanding a higher temperature than the wall, and
an insulating ring between the metallic ring and the
wall extending along at least a part of the length of
the metallic ring to provide a thermal barrier to
5 reduce the transfer of heat from the metallic ring to
the wall in the vicinity of the insulating ring.

10 The combination of the metallic ring and
insulating ring allows some control of the flow of
heat into the wall, such that heat can be directed
preferentially into parts of the wall which the
coolant reaches to moderate the temperature and
thermal stresses towards the top of the liner. Also,
by providing an insulating ring between the metallic
15 ring and the wall, the insulating ring itself is
protected from the harsh environment within the
cylinder. Although insulating materials may be able
to withstand higher temperatures than metals,
insulating materials are generally much more
20 vulnerable than metals to physical damage and to
thermal shock.

The insulating ring may be provided by an air
gap, but is more preferably a ceramic. This may be
25 sprayed on to the metallic ring and/or liner.
Alternatively, the insulating ring is a ceramic tape
which is inserted into an annular gap between the
metallic ring and the wall.

30 The cylinder may be unlined. However, preferably
it is lined, in which case the wall comprises an outer
portion and a liner, wherein the insulating ring is
between the liner and the metallic ring.

35 It has been found that positioning the insulating
ring at any location or locations along the metallic
ring provides a reduction in the local heat transfer,

but this does not necessarily reduce the temperatures and thermal stresses in the liner. The optimum performance is achieved by providing the insulating ring towards and preferably at the top end of the metallic ring as this is the location which is most difficult to cool with the coolant. The insulating ring preferably extends for only a relatively short distance from the top of the liner, namely for a distance of less than the thickness of the liner behind the metallic ring and preferably less than half the thickness of the liner behind the metallic ring.

The metallic ring is preferably made of a high temperature alloy, such as an nickel alloy, e.g. Nimonic. However, less expensive materials may be used if the temperatures allow this.

The metallic ring preferably protrudes slightly into the bore of the cylinder. In this way, it will act as an anti-polishing ring in a conventional manner to remove carbon build up on the piston crown.

For applications to situations involving high heat fluxes to the liner as a whole, the coolant passage is preferably a helical path progressing around the axis of the cylinder, as this maximises the coolant velocity and hence the heat transfer. However, any suitable form of coolant passage may be used in combination with the present invention.

An example of a cylinder constructed in accordance with the present invention will now be described with reference to Fig. 1 which is a cross section through the upper left hand portion of the cylinder and a corresponding portion of a piston.

The cylinder 1 has a cast iron or cast steel

strongback liner 2. The cylinder head (not shown) sits above the cylinder 2 in a conventional manner. A piston 3 shown partially in Fig. 1 with piston rings 4 reciprocates within the cylinder. The piston does not
5 form part of the present invention and will not be described further here.

10 The cylinder liner 2 is provided with a helical coolant path which transfers coolant liquid along the length of the cylinder.

A metallic ring 6 is inserted into an annular recess at the top of the liner 2. The ring is, preferably a high temperature nickel alloy such as
15 Nimonic. The ring protrudes slightly into the bore of the cylinder to act as an anti-polishing ring. The ring can withstand the high temperatures and stresses at the top of the cylinder without risk of distortion. It will be noted from Fig. 1 that the metallic ring 6
20 is always positioned above the piston rings 4, even at top dead centre.

An insulating ring 7 is inserted into an annular recess in the top of the metallic ring 6 between the
25 metallic ring and the liner 2. The insulating ring is preferably a ceramic such as Superwool paper.

In this position, the insulating ring 7 provides a thermal barrier between the top of the metallic ring
30 6 and the liner 2. Thus, heat which is transferred from within the cylinder to the metallic ring will be impeded from flowing through the insulating ring 7 into the very top of the liner 2. Instead, the heat is preferentially transferred to the cylinder liner
35 below the insulating ring. This effectively directs heat into a portion of the liner 2 closer to the coolant passage 5 where it can be more readily removed

by the coolant. Detailed finite element calculations show that this design reduces thermal stresses in the liner and improves the fatigue life.

- 5 The method of providing an insulating layer behind the metallic ring may also be applied to situations in which there is no liner but the cylinder is instead formed by boring out the engine casting. As in the case of a cylinder liner, the insulating
- 10 ring is protected from the hot combustion gases by the metallic ring, but the insulating ring in turn reduces the thermal stresses in the casting.

CLAIMS

1. A cylinder for an internal combustion engine, the cylinder comprising a wall generally forming the cylinder, a coolant passage to provide a flow of coolant around the wall, a metallic ring radially inward of the wall at the upper end of the cylinder, the metallic ring being capable of withstanding a higher temperature than the wall, and an insulating ring between the metallic ring and the wall extending along at least a part of the length of the metallic ring to provide a thermal barrier to reduce the transfer of heat from the metallic ring to the wall in the vicinity of the insulating ring.
2. A cylinder according to Claim 1, wherein the insulating ring is ceramic.
3. A cylinder according to Claim 2, wherein in the insulating ring is a ceramic tape.
4. A cylinder according to claim 2, wherein the insulating ring is sprayed onto the metallic ring and/or liner.
5. A cylinder according to any one of the proceeding claims, wherein the insulating ring is positioned at the top end of the metallic ring.
6. A cylinder according to any one of the preceding claims, wherein the wall comprises an outer portion and a liner, wherein the insulating ring is between the liner and the metallic ring.
7. A cylinder according to Claims 5 and 6, wherein the insulating ring extends from the top of the liner for a distance of less than the thickness of

the liner behind the metallic ring.

5 8. A cylinder according to Claim 7, wherein the
insulating ring extends from the top of the liner for
a distance of less than half the thickness of the
liner behind the metallic ring.

10 9. A cylinder according to any of the
proceeding claims, wherein the metallic ring is a high
temperature alloy.

 10. A cylinder according to Claim 9, wherein the
metallic ring is a nickel alloy.

15 11. A cylinder according to Claim 10, wherein
the metallic ring is Nimonic.

20 12. A cylinder according any one of the
proceeding claims, wherein the metallic ring protrudes
slightly into the bore of the piston to act as an
anti-polishing ring on the piston.

25 13. An cylinder according to any one of the
proceeding claims, wherein the coolant passage is
helical and progresses around the axis of the
cylinder.

30

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